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marketable emissions trading permits.

One of the conference's main themes was that climate change and climate change policy could have significant implications for agriculture. CARD Director Bruce Babcock discussed the considerable uncertainty about the effects of climate change on the environment and agriculture, and the difficulty that that uncertainty creates for establishing appropriate policy responses. Policy responses should, according to Babcock, promote "free trade and non-distorting subsidies." There are other steps that the agricultural community can take to deal with the problem, including expanding environmentally sound farming measures that are already in use and participating in carbon sequestration programs, Babcock said.

Kevin Herink, a Tama County, Iowa, farmer representing the Iowa Farm Bureau Federation, noted that Iowa farmers have been progressive in their adoption of precision farming and other conservation measures but are concerned about their ability to compete in a global market, where the playing field is not level. Clearly, the climate change debate stands to generate more research, discussion, and controversy.

Information about the conference, along with audio and text of selected presentations and links to related sites, can be found at the CARD website, http://www.ag.iastate.edu/card/about/agforum/agforum99.html.

Since 1990 the National Forum for Agriculture has promoted the discussion of national issues affecting U.S. agriculture. Each year the forum focuses on a particular aspect of agricultural policy, technology, or economics issue—usually a combination of all three. Iowa State University organized the Climate Change conference. Sponsors included the U.S. Department of Energy, the U.S. Environmental Protection Agency, the Greater Des Moines Chamber of Commerce Federation, the Iowa Energy Center, ISU's colleges of Agriculture, Engineering, and Veterinary Medicine, ISU Extension, and the Center for Agricultural and Rural Development. ♦

Whole-Farm Revenue Insurance for Crop and Livestock Producers

by Bruce A. Babcock and Dermot J. Hayes

The collapse in hog prices in the fall of 1998 has renewed interest in using insurance as a means of providing an affordable safety net to U.S. farmers. One option that has received attention is to expand the U.S. Department of Agriculture's crop insurance program to include livestock producers. Because the ongoing financial crisis in the hog sector was not caused by production or disease problems, it is apparent that producers could have benefited from either price insurance or revenue insurance.

The creation of a price or revenue insurance program raises a number of practical issues regarding what to insure, how to insure it, and how much the coverage should cost. This article discusses some of the issues raised by an expansion of revenue insurance, and provides an example of a whole-farm insurance product that insures against revenue losses from a farm that raises corn, soybeans, and hogs.

Livestock Risk

All farm operations face two sources of risk that affect gross revenue: output price risk and production or yield risk. In addition, livestock producers are exposed to significant risk arising from changes in the price of inputs such as feed. Until 1996, the only form of insurance provided by the USDA was traditional crop insurance that protects farmers against yield losses. The question arises whether insurance programs should cover both production risk and price risk or just price risk?

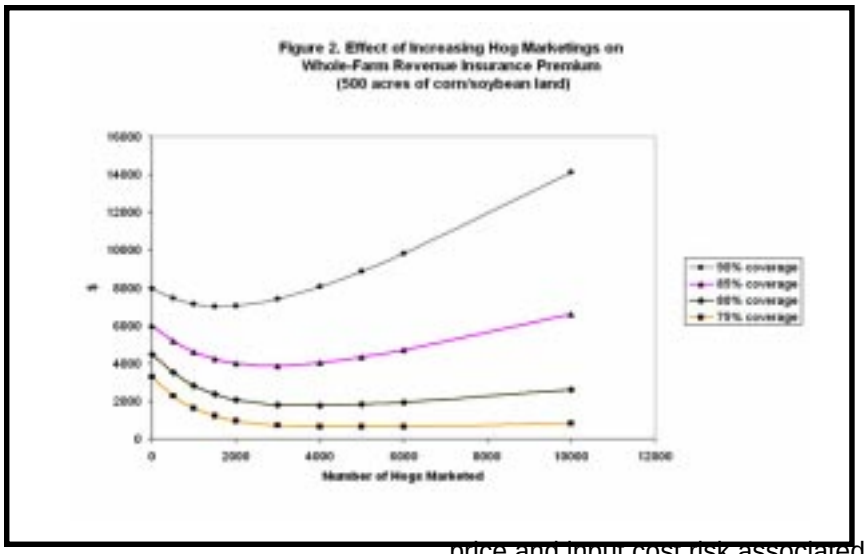
Producers generally face less risk in livestock production than in crop production. Livestock are more adaptable to variations in weather than crops, and modern operations attempt to insulate animals against stress caused by adverse weather conditions. Thus, production risk is relatively minor compared to price risk. Figure 1 illustrates the amount of price variability in the U.S. hog market and is an illustration of why it is difficult for a hog farmer to count on a certain price being available five or six months ahead.

Output prices and input costs are the two sources of most of the income risk faced by hog producers. And, variation in input costs particularly affects them. With the run-up in corn and soybean prices that began in the fall of 1995, hog production costs were much greater than anticipated. In these circumstances, an attractive insurance option would protect net revenue, i.e., output revenue less feed costs.

A Whole-Farm Safety Net

One term that occurs frequently in the debate about adding livestock revenue guarantees is the concept of a *whole-farm safety net* (or farm income safety net). In short, farmers care more about their end-of-year finances than about any of the components (enterprise-specific production levels, output prices, or input costs) that contribute to this year-end position.

From an insurance perspective, the concept makes sense because the fair insurance premiums of a whole-farm policy may be far lower than the



sum of insurance premiums on the individual components. Whole-farm policies can offer higher coverage levels as well, not only because they are more affordable due to lower risk, but also because the moral hazard problems that may occur when one component (such as yield) is insured are far less important when the policyholder has insured all enterprises on the farm. (Moral hazard is the possibility of the insurance company losing money from a claim). The possibility of protecting entire farm revenue at a high, but affordable, coverage level creates the safety net that is much in demand.

Whole-Farm Revenue Insurance Incorporating Livestock

The most straightforward way to incorporate livestock into a farm safety net would be to add the output price and input cost risk associated with livestock enterprises to an existing whole-farm crop or revenue insurance policy. To date, the only commercially available whole-farm, crop revenue policy is an option under Revenue Assurance (RA). This crop revenue insurance product is owned by the American Farm Bureau Insurance Services Inc., and is now sold in six states in the upper Midwest.

Before working out an example, we must account for some of the differences between crops and livestock. Crop farmers generally harvest once per year, at a predictable time, and the price used to value harvest is the price that occurs at harvest time. For example, for Crop Revenue Coverage (CRC) and RA, the price used to value harvested corn is the average November quote of the December futures contract on the Chicago Board of Trade. With livestock, however, "harvest" can occur many times during the year. A livestock revenue insurance policy should be flexible enough to match the harvest price with livestock delivery.

For hog producers, the Chicago Mercantile Exchange has seven futures contracts in a given year: February, April, June, July, August, October, and December. Typically, farmers have a good idea about both the timing of deliveries and the quantity that will be delivered each year. A sensible way of determining an expected hog price to use is to construct a weighted-average settlement price, with weights given by the number of hogs to be marketed in each contract month. For example, suppose a farmer plans on delivering 100 hogs in April, June, and August, and 200 hogs in October and December, and the current prices (adjusted to a per 100 pounds live-weight basis) on these contracts are $50, $50, $40, $45, and $45, respectively. Therefore, the expected live hog price per 100 pounds used to value the average hog produced that year would equal $45.71.

We would then need to adjust this expected live hog price for an expected feed cost. In the example cited, we use the corn and soybean futures markets to calculate an expected total ration cost for each hog. For example, if the December corn contract was trading at $2.50 and the November soybean futures were at $5.50, then our expected ration cost would equal $0.176 per pound of live animal. The producer would then have expected net revenue of $28.11 per 100 pounds. Actual futures market settlement prices would later be used to calculate the actual net revenue using the same methods. A component of the whole-farm revenue guarantee would then be the difference between actual and actual net livestock revenues.

The timing of the revenue guarantee is a factor to consider. For spring-planted crops in the Midwest, March 15 is the sales closing date for crop insurance policies. Correspondingly, CRC and RA use the average February

quote of the December futures contract for corn as the price used to set revenue guarantees for corn. In the example, we maintain a March 15 sales closing date and use the average of the first five trading days in March as the projected price for each of the live hog futures contracts.

The way this example contract is set up, the farmer has until March 15 to determine the number of hogs that will be guaranteed under each futures market contract. This will subsequently determine the whole-farm revenue guarantee. The amount of market revenue from hogs that will be added to harvest revenue from crops to determine whole-farm revenue can be determined only upon settlement of the last futures market. Waiting for the last futures contract to close may delay calculation of whole-farm revenue because crop revenue from corn is known on December 1, and payment of indemnities will have to wait if the farmer plans on delivering hogs under the December or February contract.

A Representative Corn-Soybean-Hog Farm

To show the effects of adding hogs to a corn-soybean whole-farm insurance contract, we look at a 500-acre farm in Webster County, Iowa, with 250 acres each of corn and soybeans. Projected local prices of corn and soybeans in the fall are $2.10 and $5.00, respectively. The approved yields are 135 bushels for corn and 40 bushels for soybeans. We determine the cost of coverage by calculating how much an insurance company would lose on average if it sold this producer this policy for 5,000 years.

Figure 2 shows how the introduction of hogs affects the actuarially fair whole-farm premium for this farm. When no hogs are marketed, the fair premium depends only on the percent of expected crop revenue insured. The formula for expected revenue from crops is springtime price × expected yield × acres for each crop—$123,500 for the 500 acres. At 90 percent coverage, the whole-farm revenue guarantee is $111,150, and the fair premium is $7,936. At 85 percent coverage, the fair premium is $6,004. At 80 percent and 75 percent coverage levels the fair premiums are $4,479 and $3,020. For a 500-acre crop farmer, a 90 percent premium of almost $8,000 is probably not affordable and may raise concerns regarding moral hazard.

When we add 2,000 hogs to the mix, however, the whole-farm fair premium actually *declines* (see Figure 2) even though hogs greatly *increase* the level of the revenue guarantee. The premium decreases as the amount of insurance increases because a corn-soybean-hog farmer is more diversified than a corn-soybean farmer, and greater diversification means lower risk.

The premium rate declines because hog prices are largely uncorrelated with corn and soybean prices; that is, when corn and soybean revenue is low, there is a 50 percent chance that hog revenue will be greater than expected. Thus, adding hogs significantly lowers the probability that an indemnity will be paid on corn and soybeans. Additionally, because revenue from hogs is less variable than corn and soybean revenue, the premium rate continues to decline as a farmer specializes in that less risky enterprise.

Figure 2 shows that premium rates eventually rise as more hogs are marketed. The turning point depends on the coverage level. When 3,850 hogs are marketed at the 90 percent coverage level, the whole-farm premium with hogs equals the whole-farm premium without hogs. The difference is that the farmer who markets 3,850 hogs has $239,663 more insurance coverage than the farmer who markets no hogs.

The break-even number of hogs at 85 percent coverage is 8,800 hogs. At 80 percent coverage, the break-even number of hogs is approximately 19,000. As shown, the power of diversification means that a farmer can have a lower insurance premium even though the amount of insurance increases. A common response to this type of diversification is to increase coverage level. For example, if this farmer were to include 5,500 hogs in a whole-farm revenue insurance policy, the total fair premium at 85 percent coverage is approximately equal to the total premium at 80 percent coverage for a crop-only whole-farm policy. The fair premium is the same, but the whole-farm revenue guarantee increases by $328,500, from $96,700 to $431,279.

The Next Phase

The U.S. agricultural insurance program has evolved from insuring only individual crop yields to insuring the combined revenues from several crops. The next phase may involve the addition of livestock. Here, we argue that the most effective way to insure livestock is to insure expected annual production against output price risk and input cost risk. We also argue that it would be technically feasible to add this livestock net revenue guarantee to existing whole-farm crop revenue guarantees.

These policies could complement existing financial instruments offered on the Chicago Mercantile Exchange and the Chicago Board of Trade. In some preliminary sample rates presented here, we show that the addition of livestock to whole-farm revenue guarantees can dramatically *reduce* both insurance rates and insurance premiums. These lower rates make 90 percent coverage affordable and economically justified. The availability of a 90 percent revenue guarantee would create a farm income safety net for large numbers of diversified family farms.♦